



Mount St Helens National Volcanic Monument – Teacher's Corner 2003
Gifford Pinchot National Forest
USDA Forest Service

Rating Erosion Rates

Lava Canyon Trail Activity

Teacher Information:

Time Commitment: 1 hour and 30 minutes

Location: Lava Canyon

This activity requires committed and active participation from chaperones in order to ensure student safety. The activity and trail is not recommended for groups larger than 45 students and chaperones. Students will make observations and conduct experiments to determine if rock formations in Lava Canyon are eroding at the same rate or at different rates.

Students will be better served if they have prior knowledge of the following vocabulary words:

- 1) Erosion: The physical and chemical weathering of rock caused by wind, water and other natural forces.
- 2) Lahar: An Indonesian term for a mudflow that originates on the slope of a volcano. A flow of water-saturated volcanic debris.
- 3) Mudflow: A flow of water-saturated earth possessing a high degree of fluidity during movement.
- 4) Red Alder: A deciduous tree that often colonizes disturbed sites.

Goal:

- 1) Students will be able to use imaginative and analytical skills to develop and evaluate models about the erosion rates of rock formations in Lava Canyon.

Objectives:

- 1) Students will understand that rates of erosion vary depending on the type of rock and erosional agents.
- 2) Students will use analytical skills to evaluate the validity of multiple explanations for a phenomenon.
- 3) Students will be able to describe the characteristics of a lahar.
- 4) Students will stay on the trail at all times.

Rating Erosion Rates

Lava Canyon Trail Activity

Your Mission: (purpose) To determine if the black and yellow rock formations are eroding at the same or different rates.

Possible Explanations: (hypothesis)

- #1: Lava Canyon's black and yellow rock formations erode at the same rate.
- #2: Lava Canyon's black and yellow rock formations erode at different rates.

Case Facts: (materials)

- An evergreen forest grew within Lava Canyon until May 18, 1980.
- Lahars are flows of mud, rock, trees and debris that look and move like wet, flowing concrete.
- Deciduous trees like Alder colonize disturbed areas.

Evidence Evaluation (procedure) and Observations (record data)

Use your observation skills and the case facts to evaluate evidence of erosion along the trail. You will be comparing the erosion rates of a yellow rock formation and black rock formation. After documenting and describing your observations, determine if the black and yellow rock formations are eroding at the same rates or at different rates.

- A. A lahar flowed through Lava Canyon on May 18, 1980. Observe the canyon before you and the case facts listed to determine how the lahar caused erosion in Lava Canyon? Describe any evidence of erosion you have observed.

- B. The swirling water above the waterfalls appears to be slowly eroding the black lava flow. However, rock is harder than water. Find a rock along the trail, walk to the bridge, and drop the rock in the water. What happened to the rock as it landed in the water? What is the water carrying that could cause erosion?

Case Facts: (materials)

- The black rock formation is part of an andesite lava flow from Mount St. Helens that is about 2000 years old.
- The yellow rock formation is part of a 20-million year old volcanic mountain range that has changed over time and has become clay rock.
- Rocks of different hardness erode at different rates.
- Hard volcanic rocks make a clinking sound when struck together.
- Soft volcanic rocks make a dull thud when struck together.

Evidence Evaluation (procedure) and Observations (record data)

Use your observation skills, the case facts and results from the following experiments to compare and contrast the erosion rates to a yellow rock formation and black rock formation.

- C. There are piles of yellow, black and gray rocks at the bottom of the stairwell. Pick up one rock from each pile. Examine the yellow and black rocks and predict which rock you think will be harder?

- D. Scratch the yellow and black rocks together, and record which rock was harder.

- F. Hit the yellow and black rock samples with a gray rock, and describe the sounds when each rock was struck. Put all of the rocks back where you found them.

Conclusion:

- a) I think that explanation # _____ is best. ; OR
b) I have reached a different conclusion

In complete sentences, explain the evidence you used to support your conclusion.

Teacher Answer Sheet to Rating Erosion Rates

Your Mission: (purpose) To determine if the black and yellow rock formations are eroding at the same or different rates.

Possible Explanations: (hypothesis)

#1: Lava Canyon's black and yellow rock formations erode at the same rate.

#2: Lava Canyon's black and yellow rock formations erode at different rates.

Case Facts: (materials)

- An evergreen forest grew within Lava Canyon until May 18, 1980.
- Lahars are flows of mud, rock, trees and debris that look and move like wet, flowing concrete.
- Deciduous trees like Alder colonize disturbed areas.

Evidence Evaluation (procedure) and Observations (record data)

Use your observation skills and the case facts to evaluate evidence of erosion along the trail. You will be comparing the erosion rates of a yellow rock formation and black rock formation. After documenting and describing your observations, determine if the black and yellow rock formations are eroding at the same rates or at different rates.

- A. A lahar flowed through Lava Canyon on May 18, 1980. Observe the canyon before you and the case facts listed to determine how the lahar caused erosion in Lava Canyon? Describe any evidence of erosion you have observed.
- The lahar carried away the forest and soil from Lava Canyon, and exposed a black lava flow and ancient yellow rock formation. Bark was removed from evergreen trees along the edge of the canyon, indicating the depth of the flow. Small deciduous trees (alder) that have colonized the canyon since 1980 also reveal the depth and route of the lahar. Rocks carried in the lahar banged against the bottom and sides of the canyon. A variety of different sized and colored rocks were deposited in the streambed.

- B. The swirling water above the waterfalls appears to be slowly eroding the black lava flow. However, rock is harder than water. Find a rock along the trail, walk to the bridge, and drop the rock in the water. What happened to the rock as it landed in the water? What is the water carrying that could cause erosion?
- The rock was pulled downstream by the current. This indicates that the water is carrying rock and sediment that scrapes against the black rock formation above the waterfall. Rock and sediment carried in the water must be slowly eroding the canyon.
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Case Facts: (materials)

- The black rock formation is part of an andesite lava flow from Mount St. Helens that is about 2000 years old.
- The yellow rock formation is part of a 20-million year old volcanic mountain range that has changed over time and has become clay rock.
- Rocks of different hardness erode at different rates.
- Hard volcanic rocks make a clinking sound when struck together.
- Soft volcanic rocks make a dull thud when struck together.

Evidence Evaluation (procedure) and Observations (record data)

Use your observation skills, the case facts and results from the following experiments to compare and contrast the erosion rates to a yellow rock formation and black rock formation.

- C. There are piles of yellow, black and gray rocks at the bottom of the stairwell. Pick up one rock from each pile. Examine the yellow and black rocks and predict which rock you think will be harder?
The black rock feels and looks harder than the yellow rock.
- D. Scratch the yellow and black rocks together, and record which rock was harder.
The yellow rock left yellowish streaks on the black rock when they were scratched together. This indicates that the black rock is harder.
- F. Hit the yellow and black rock samples with a gray rock, and describe the sounds when each rock was struck. Put all of the rocks back where you found them.
The yellow rock made a thud noise when struck, indicating that it is softer. The black rock made a clink sound when struck, indicating that it is harder.

Conclusion:

- a) I think that explanation # 2 is best. ; OR
b) I have reached a different conclusion

In complete sentences, explain the evidence you used to support your conclusion.

The scratching and rock "sound" experiments indicate that the yellow rock formation is softer than the black rock formation. Lava Canyon's black and yellow rock formations must erode at different rates. Note the long thin black "fins" of lava in the canyon. The Muddy River has taken the pathway of least resistance. It tends to flow around the hard black lava flow and deeply eroded the soft yellow rock formation. The river tends to erode the yellow rock beneath the lava flow, until it undercuts it so much that it causes the lava flow to collapse. Over time this process has sculpted tall, thin black fins of lava visible throughout the canyon.

Instructional Sequence for “Rating Erosion Rates”:

1. Before your arrive at the Lava Canyon Trailhead. Have your bus driver drive pull into an oversized vehicle parking area just past the Moss Springs Viewpoint Entrance sign on forest road 83 (right hand side). Do NOT pull into this parking lot, because it cannot accommodate oversized vehicles. This pullout located ½ mile from the Lava Canyon Trailhead, and is nestled within an area inundated by the 1980 lahar.
 - A. Explain that in order to appreciate Lava Canyon’s appearance today that students must first understand the shoestring glacier story. If the volcano is visible point to the deep trough running down from the crater rim to the base of the volcano. This holds the remnants of Shoestring glacier, which carved the trough. The glacier use to stretch another 1300 feet upward from the current summit.
 - B. Explain that within seconds after the eruption began on May 18, 1980 an enormous, turbulent dark cloud surged down all sides of the volcano. The cloud reached the base of Shoestring Glacier in 90 seconds. This hot cloud melted 27 feet of ice from the glacier, creating a mudflow—a flow of mud, rock, trees and debris. This mudflow, called a lahar, looked and moved like wet flowing concrete.
 - C. The lahar, traveling nearly 60 mph, grew as it surged down slope scouring away the forest. When the lahar reached the site where your school bus is parked it was nearly 15 feet deep. You can see how deep it was by looking at standing dead trees along the edges of the lahar. The bark was removed when boulders inside the lahar bashed against the tree. Some trees on the hillside behind us also have these ‘flow marks’ on them, where the bark was removed by the abrasive flow. Large rocks like those scattered around you actually floated on the surface of the wet-concrete-like flow. These are not new rocks; rather, this is old material from the former summit.
 - D. Part of the lahar flowed down the Pine Creek drainage (the ridge line behind the bus), but the rest of it was deflected down Lava Canyon to our right. The lahar scoured out the canyon—removing the forest, exposing a lava flow and an ancient rock formation that we will be hiking over.
 - E. By 9:00 am, 17 million cubic yard of debris, enough to fit on a football field nearly 3,000’ high, had entered Swift Reservoir--the large body of water your bus passed just outside of Cougar. This debris also raised the water level of the reservoir two and a half feet. This lahar was impressive, but it wasn’t the largest mudflow on May 18th. A lahar that went down the North Fork of the Toutle River was four times larger in volume!
2. Drive to the Lava Canyon trailhead, disembark and provide a bathroom break.
3. At the trailhead, inform the students that they will be conducting an activity near a fast-moving, cold river (glacial melt water) and cliff faces. It is imperative that

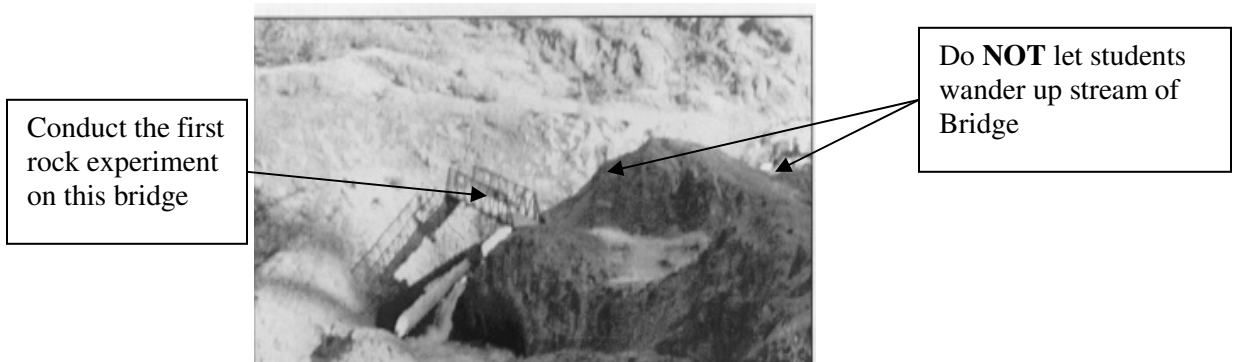
students stay on the trail and remain with their adult chaperone at all times. Fatal accidents have occurred in Lava Canyon when people got off the trail. Set clear expectations for student conduct along the trail—for example: anyone caught off trail or who does not listen to their chaperone will be sent back to the bus with their chaperone and group and receive a failing grade.

4. Walk about ¼ mile on the paved section of the trail to a large boardwalk platform overlooking Lava Canyon. Explain how to complete the student worksheet “*Rating Erosion Rates*” Explain that the May 18, 1980 lahar flowed down lava canyon. Explain that the 15-foot deep lahar was constricted as it entered Lava Canyon, causing the flow to raise to a height of up to 65 feet deep! Provide students with 5 to 10 minutes to answer question A on their worksheet.



View from Boardwalk Platform

5. Walk another ¼ mile on the boardwalk and paved section of the trail to the intermediate trail intersection on the right side of the trail. Proceed 50-feet down the unpaved intermediate trail and stop at the waterfall viewpoint with a metal fence. At the metal fence, point to the polished potholes in the streambed above the waterfall then point to the footbridge just upstream of the potholes. Explain that students will be conducting an experiment with their chaperones on the footbridge in order to answer question B on their worksheet.
6. Position yourself at the bridge. Instruct the students to pick up a small rock along the edge of the trail. Allow two student groups accompanied by two chaperones to proceed to the bridge at one time. Create a “chaperone sandwich” at the bridge—all students in between the chaperones—while students conduct the experiment to answer question B. Instruct the students to go immediately to the next stop at the bottom of a metal stairwell where they will write down their observations. Do NOT let students waiting for others to complete the assignment wander--especially upstream of the footbridge!



Bridge Erosion Experiment Site

7. About 10-feet beyond the bottom of the stairwell you will find a three rock piles on the left side of the trail. There will be a pile of yellow rocks, black rocks and gray rocks. Distribute the black and yellow rock samples to each student group. Remind students to use visible evidence at the site and the case facts, then allow the group 10 to 15 minutes to complete the experiments and discuss the questions to questions C-E. Move from group to group during this time to address concerns and questions. When students complete these questions, they should be able to determine which explanation is best.
8. Allow each group of five students to reveal which explanation they thought was best, and to explain how they reached their conclusion. Review the answers to each question then describe why explanation #2 was best. The rock scratching and rock “sound” experiments indicate that the yellow rock formation erodes at a faster rate. In addition, by observing the landscape downstream from the viewpoint, you can determine that the river has flowed around the hard black lava flow and deeply eroded the soft yellow rock formation.
 - a. This is why there are tall thin “fins” of black rock visible down canyon. The river flows around both sides of the hard black rock and cuts deeply into the soft yellow rock beside it and beneath it. The yellow layer slowly eroded out from under either side of the black lava flow. Eventually the black lava flow becomes so undercut that it collapses, forming the black lava “fins” visible downstream.
9. Return to bus via the route you came. *OR:* If you want a longer hike, proceed another $\frac{3}{4}$ mile on a more difficult trail that loops back to the easier paved trail. The suspension bridge that passes over the canyon on this more difficult section provided students with a memorable experience. *NOTE:* There are **forty to fifty foot vertical cliff faces along most of this trail segment!** Station chaperones between each group of five students when hiking this trail, and instruct the chaperones not to let any students pass them. Allow an additional $\frac{3}{4}$ hour if hiking the more difficult loop trail.